ED 259 503 EC 180 239

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TITLE Training Between Class Generalization of Toy Play Behavior to Children with Severe and Moderate Handicaps.
INSTITUTION California Univ., Santa Barbara.
SPONS AGENCY Special Education Programs (ED/OSERS), Washington, DC.
PUB DATE Aug 84
GRANT G008104154
NOTE 59p.; In its: The Socialization Research Project. Final Report, Appendix C, August 1984 (EC 180 236).
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PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Early Childhood Education; *Generalization; *Play; *Severe Disabilities; Social Development; Toys

ABSTRACT

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Training Between Class Generalization of Toy Play Behavior to Children with Severe and Moderate Handicaps

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Running Head: Between Class Generalization

The research was supported by a Field Initiated Research Grant, # G008104154, Special Education Program, U.S. Department of Education. The author would like to thank John Healy and Blair Roger for their administrative support throughout the study; Melanie Lee for conducting the study on a daily basis; and Robert Gaylord-Ross and Cathy Breen for sudstantial help. Requests for reprints can be sent to Thomas Haring, Graduate School of Education, University of California, Santa Barbara, CA, 93106.

Abstract

This study describes a training program in which young children with severe and moderate handicaps were taught to generalize play responses to multiple sets of toys. A multiple probe design, replicated with four children was used to assess the effects of generalization training within four sets of toys on generalization to untrained toys from four other sets. The responses taught were unique for each set of toys. Results indicated that training to generalize within two sets of toys was associated with stimulus generalization of other sets that did not formerly show generalization in three participants. Probes were also taken on responses to two additional sets of toys that differed from the previous sets in topography and in the effects that the toys produced. While the participants generalized to between 50% and 100% of the toys that were similar in responses and effects they did not generalize to toys from the disimilar sets. Implications for conducting research using strategies based on response interrelationships in training contexts are discussed.

Training Between Class Generalization of Toy Play Behavior to Children with Severe and Moderate Handicaps

Although developmental psychologists have described responses as occurring in organized systems (e.g. Piaget, 1980), and have indicated that the organization of responses may influence generalization (Husiam & Cohen, 1981), behavior analytic reseachers have only recently studied some of the possible effects of response interrelationships. The recent interest in response-response relationships is largely due to the introduction of principles from behavioral ecology into the behavior analytic literature (Willems, 1968,1974; Warren & Rogers-Warren,1977). Voeltz and Evans (1982) reviewed the existing literature concerning response interrelationships. In those studies reviewed, response interrelationships were usually defined as an alteration in the frequency of a response when the frequency of another response changed as a function of changes in environments or the addition of a treatment variable.

The construct of the response class (Skinner, 1935,1953) has been invoked to theoretically account for observed interrelationships between responses (e.g. Sherman, 1964). Inherent in the definition of a response class is that responses may occur under the same or similar stimulus conditions if the responses are effective in producing similar effects. Therefore, an alteration designed to effect a single response may also effect functionally related responses.

Two strands of research have contributed demonstrations of response-response relationships. A variety of statistical models have been employed to identify clusters of responses including factor analysis (Kara & Wahler, 1977), cluster analysis (Lichstein & Wahler, 1976), and lag sequential analysis (Strain & Ezzell, 1978). Following this strand of research, Strain and Ezzell coded the behavior of 18 behavior disordered adolescents under three environmental situations using an 11 category system of classification. They found that three stable patterns of responses were identifiable.

Another research strategy has established an intervention oriented approach. For example, Wahler, Sperling, Thomas and Teeter (1970) measured behaviors in two response classes; "mildly deviant behavior" and stuttering. An intervention designed to reduce stuttering also reduced the other problematic behaviors as a collateral effect. Within language research several studies (e.g. Guess & Baer, 1973; Lee, 1981; Whitehurst, 1977) have shown interrelationships (with some individual differences) between receptive and productive language acquisition. Several studies have found inverse relationships between behavior problems and more situationally appropriate behaviors (e.g. Haring, Breen, Pitts-Conway & Gaylord-Ross, 1984; Koegel & Covert, 1972; Russo, Cataldo, & Cushing, 1981). Although response interrelationships have frequently been documented when multivariate measurement strategies have been utilized, interrelationships are not an inevitable product of behavioral interventions. For example, Neef, Shafer, Egel, Cataldo, and Parrish (1983), demonstrated that compliance training with "do" requests did not generalize to "don't" requests. Given that many studies have found response interrelationships either as directly programmed effects or as unintended effects, the implication can be made that a technology to generate response interrelationships is possible if the variables that control the formation of response-response relationships can be identified and functionally controlled.

While the effects of response interrelationships can be evaluated, there is little data concerning how the response interrelationships were initially formed. It would be useful to know if procedures designed to facilitate acquisition of new response-response relationships could be developed. Research that validated procedures which promote response class relationships would have considerable significance to applied research in that such methods offer the potential to increase the economy of behavioral interventions. Parenthetically, because severely handicapped learners are defined on the basis of educational need (Sontag, Smith & Sailor, 1977), models for the acquisition of new response clusters (e.g. Holvoet, Guess, Mulligan and Brown, 1980) would be more useful than models for changing the frequencies of existing responses.

There has been no research concerning the effects of response interrelationships on stimulus generalization although Casalta (1980) has suggested this possibility. Theoretically, it is possible that if responses are functionally related, the stimulus generalization of one response may mediate the stimulus generalization of another response. For example, suppose that a student has been trained to assemble some product that requires the use of a screwdriver and a wrench at distinct steps of the assembly. Natural variation of both screws and bolts exist to which the student should generalize. Although screwing and bolting responses have some topograghic similarities, there are obvious differences in the responses. If there is a functional relationship between the bolting and the screwing response classes, it is possible that programming to promote the generalization of one response class to its corresponding stimulus class would produce the generalization of the functionally related response class in the absence of direct programming. A model to study some effects of response interrelationships on stimulus generalization will be tested in the present investigation.

The model to be tested in the present study is an extention of the strategy of "training sufficient exemplars" (Stokes & Baer, 1977). Within the present model, stimulus sets; in contrast to individual stimuli, are treated as exemplars of a higher order category. Specifically, a series of S-R relationships are established for a number of responses. Next, training is introduced to promote the generalization of some of the trained responses to their corresponding stimulus sets. As stimulus generalization is sequentially trained across a variety of responses, generalization probes are conducted with the remaining untrained stimulus sets. After some sufficient amount of generalization training, spontaneous generalization of sets of stimuli may occur to their respective response classes. The model can be refered to as "response mediated generalization" because the stimulus generalization of some response(s) mediates the stimulus generalization of functionally related responses to their corresponding sets of stimuli. The model is directly analogous to the training of sufficient exemplars because new sets of stimuli can be progressively layered in until spontaneous generalization occurs between other responses and untrained sets of stimuli.

In the present study, four severely or moderately handicapped children will be trained to play with a variety of toys. Toy play responses were selected to investigate the model because the learning of a diverse set of play responses which are appropriately generalized to a wide variety of toys is recognized as important for students with severe disabilities (Wehman, 1979). In summary, the study has two related purposes. One purpose of the study is to teach the participants some needed toy play responses. In addition, the major purpose is to assess the effects of generalization training across functionally related responses on the subsequent generalization of other related responses.

Method

Participants and Setting

Four children attending classes for moderately and severely handicapped students participated in the study. The participants' classrooms were located in a regular elementary school building and were operated by a public school system. The participants engaged in unstructured toy-play with nonhandicapped children on a regularly scheduled basis. The participants were selected because they displayed low rates of appropriate toy manipulation. Summaries of recent test results and descriptive data are given in Table 1.

Insert table one about here

Mick spoke in two word phrases and could label a large variety of objects. Receptively, he could carry out commands such as "turn off the lights" or "go get a waste basket". Mick had been trained to complete many self care skills; however, he still required instruction in zipping, buttoning and shoe tying. He could learn new responses through imitation.

Charles rarely produced spontaneous speech, although he was capable of labeling responses. Receptively, he responded to two or three word commands such as "look at me" or "go to the door". Charles was not toilet trained and could not chew solid foods. He displayed no imitative responses during instruction.

Jim could follow two or three word commands. He spontaneously greeted familiar people and asked questions such as "what's that?" The maximum length of his utterances was four words long, although he typically spoke in two word utterances. He had been taught to identify several printed words on sight, but demonstrated inconsistent comprehension of sight words. He was capable of learning through imitation.

Jane could independently dress herself. She could respond correctly to two word commands and could label a variety of objects. She knew the names of the five other children in her class. She could produce three word utterances, but she typically spoke one word statements. She had excellent imitative ability.

All training and generalization sessions were conducted in a 6m by 8m office adjoining the participants' special education classrooms. The sessions were conducted at a 1m by 3m table with the instructor seated across the table from the participant. All training and probe sessions were conducted individually. The instructor was a female graduate student in the severely handicapped area at San Francisco State University.

Materials

Each participant was exposed to eight different sets of toys from the following ten sets: animals, people, bugs, frogs, motorcycles, airplanes, boats, snakes, tanks, spaceships. Each set of toys contained five examples. The toys in each set varied in terms of size, color and "abstractness". The range of abstractness within in each toy set was produced by selecting toys such that the toys in the set shared a small set of common configurational properties (see Table 2). The most abstract toy in each set consisted of cut out wood forms with no details other than the defining configurational elements. The other toys in each set were selected to possess the defining properties and progressively more and different details. For example, the most abstract toy airplane consisted of two Lincoln Logs crossed at right angles and attached with Scotch Tape. The least abstract airplane was an accurate 1/100 scale 747 jet.

The sets of toys were divided into three experimental groups. Four sets of toys were designated as generalization training sets. For example, Jane's generalization training sets were snakes, boats, tanks, and people. Another four sets were designated as generalization probe sets. For example, Jane's generalization probe sets were animals, airplanes, bugs, and spaceships. Finally, two sets of toys (wind-ups and keyboard instruments) served as an additional group of generalization probe sets. This second group of generalization probe toys was added to assess the spread of response mediated generalization to sets that required substantially different responses. That is, all other toy sets in the study were played with by physically moving the toy through some pattern of responses. In contrast, both the wind-up toys and the keyboard instruments produced effects that were more reactive in nature. These toys are refered to as reactive because once a response is made with the object (either winding it up or pressing a key) the object itself produces an effect that is potentially noticable. Since the toy sets of reactive toys produce distinct effects from the other toys, they were analyzed seperately. The sets of reactive toys contained three objects each (only three objects were included in these sets because of difficulty in locating multiple examples of keyboard instruments). Table 2 shows the characteristics of the reactive toys as well as those which required movement responses.

For each participant, the movement related toys were randomly assigned to either the generalization training or generalization probe group of sets. However, the assignment was controlled so that no one toy set was allowed to be used more than twice in either group of toys across the four participants. In addition, if a toy was used once (or twice) in either the generalization probe or training groups it was used once (or twice) in the other group of sets. For example, if frogs had been randomly assigned twice to two participants as a generalization training toy, the frog set would be assigned as a generalization probe set to the two remaining participants. This procedure was followed to ensure that all of the sets were sampled and so that any set appeared an equal number of times in generalization probe and training sets. Table two indicates that the toys were organized into

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Insert table two about here

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sets on the basis of sharing a common set of configurat'onal attributes.

Response Definitions

The responses to be taught were specific to each set of toys. For example, with spaceships the participants were taught to move the toy through the air in a circular motion and land it at a right angle to the table. In contrast, airplanes took off from the table at a lesser angle and flew in straight lines. Thus, the responses for each toy set were differentiated. A summary of toy types and responses is given in Table 3.

Insert table three about here.

Procedures

Baseline probes. The participants received a minimum of two trials with each of the 46 toys to be used during the study. Verbal praise was given during the probes by saying "good working" before the trainer showed the participant a toy. Praise was given during baseline sessions to keep the students level of interest in the task relatively constant throughout the session and to keep the density of praise fairly constant between baseline and training trail (although this was not systematically controlled). Toys were handed to the participant with the instruction, "play with this". The participant was then given 15 sec to play with the toy.

Training with the first examples from the generalization probe sets. Following the baseline probes, the participants were trained to produce the specific responses with the most detailed and realistic toys from each generalization probe set ("first examples"). During this training phase, the participants were also trained to play with one keyboard and one wind-up toy. Each session contained 15 training trials . One session was conducted each school day.

The trials began with the instructor saying "play with this". The instructor then handed the participant the toy and observed whether or not the correct sequence of responses was produced. If within 10 sec the student did produce the correct response pattern, enthusiastic verbal praise was delivered. If the student did not produce the correct pattern, the instructor said "No, do it like this" and simultaneously modelled the correct sequence. If the student then correctly imitated the response, the instructor said "Good" and presented the next toy to be trained. If the participant did not correctly imitate the response, the instructor said "No, do it this way." The instructor then physically guided the responses by placing the participants hand on the toy and guiding the correct movement. No verbal praise or feedback followed manually guided responses. The criterion for ending training with a toy was set at three consecutive correct responses. Training was conducted in a spaced trial format in that maintenance and generalization probe trials with other toys were dispersed between instructional trials. Including training, maintenance and generalization trials, sessions typically lasted 15 min.

<u>Generalization training with movement related toys</u>. After the participants reached criterion with the four first

examples from the generalization probe sets, generalization training with other movement related toy sets was begun. A multiple exemplar strategy was employed to promote generalization within the training sets (Stokes & Baer, 1977). The participants were first trained with the most detailed, realistic toy from each set. After the training criterion was met with that toy, the more abstract toys were trained one-by-one until generalization to the remaining untrained toys in the set occurred. The order of introduction of the generalization training sets was randomly determined for each student. The training procedures were identical to those used during the previously described training phase. As during the initial training phase, any unprompted correct response recieved enthusiastic praise.The criterion for switching from one toy set to another was either:

a) when the participant generalized to all remaining toys in a set, or

b) when training was completed with all toys within a set to which the student had not generalized.

Each session lasted 15 minutes and contained 15 training trails.

<u>Generalization probes</u>. The experimental sessions were organized so that probe trials were randomly dispersed between training trials. A maximum of seven toys per day were probed. The probe trials began with the statement, "play with this", as did the training trials; however, during probe trials no prompt or praise was delivered. Generalization

probes were conducted with untrained movement related toys as well as with the untrained reactive toys.

Maintenance probes. Each of the four "first example" toys from the movement related sets as well as the two reactive toys which were trained during the first training phase were probed throughout the duration of the study to ensure that the responses were maintained. If the responses were incorrect during a maintenance probe, the correct pattern of behavior was prompted as during the training trials in order to ensure that the responses remained in the participants repertoire of play responses. Correct responses recieved praise from the instructor.

Measurement and Reliability.

The dependent measure during all experimental sessions was the frequency of correct responses for each training or probe toy. A correct response was defined as producing the exact pattern of behavior defined for a given toy within 10 sec of receiving the toy.

Totaled across the four participants, 148 sessions were conducted. Reliability probes were taken 20 times. Reliability probes were conducted under each experimental condition and with each student by the instructor and the author. Each observer independently scored the child's play as to the occurrence or nonoccurrence of the correct pattern of responses for that toy as defined in Table three. The reliability coefficient was calculated with the formula:

$$\%\ \text{interobsever agreement} = \frac{\#\ \text{of agreements}}{\#\ \text{of agreement} + \#\ \text{of disagreements}} \times 100$$

Reliability was calculated on a point-by-point basis (Kazdin, 1982). The session reliability for the occurence of target responses ranged from 82% to 100% with a median of 100%. The session reliability for non-occurences was 100% for all sessions except one session for which the percent agreement was 89%.

Design

A multiple probe design was employed. The multiple probe data was collected within a design that conformed to a multiple baseline across responses design (Hersen & Barlow, 1976; Kratochwill, 1979; Kazdin, 1982). The multiple baseline analysis was conducted during the first training phase of the study. After stable baselines were achieved for the four "first example" toys, one toy was selected for training. When a reliable change in behavior with the first toy was obtained, the same intervention was used to sequentially alter the play behaviors with the remaining toys. Functional control over the play behaviors was inferred when the correct play behaviors occurred only when the training intervention was initiated. A separate multiple baseline analysis was also conducted with the generalization training data.

Results

First Example Training of Toys From Generalization Probe Sets

The percentage of correct play behaviors with the most detailed toys ("first examples") from the four probe toy sets is represented in Figures 1, 2, 3 and 4. The baseline data across the four participants shows that no correct responses were produced. Jane's data (Figure 1) indicated that correct responses with the first example from the animal set were produced during the second training session. After the fifth day of training with the toy animal, training with the first airplane was begun. Intervention with the first example from the toy bug set was started after two days of training with the toy airplane since the change in performance from the baseline level was apparent. Instruction with the first spaceship was begun after two days of instruction with the toy bug. Jane's data show that there was no increase from baseline levels until intervention with a toy was begun. With all four toys, Jane rapidly met the training criterion once the intervention was begun.

Insert Figure 1 about here

The data for Mick are represented in Figure 2. Intervention with the first examples of the toy airplanes and toy animals produced correct responses during the first training session for each toy. Also, for both of those toys, Mick achieved 100% correct responses by the third day of training. In contrast, the initial acquisition of play responses with the toy snake and toy tank was slower. Correct responses were observed on the second and third days of training for the first example of tanks and snakes respectively. Mick achieved 100% correct responding with the most detailed toy snake by the fifth day of training and he achieved 100% correct with the first tank on the fourth day. Thus, for the four first example toys, Mick rapidly acquired the correct play responses when the intervention was introduced .

Insert Figure 2 about here

Jim's data (Figure 3) indicate that the intervention was effective in increasing the level of correct responding across all four representational toys. One hundred percent correct responding was achieved within five days for the toy person, snake and boat and within four days with the toy motorcycle. The data for the toy person show that when training began with the toy snake, the performance dropped to zero percent with the toy person. On the day that training was begun with the toy snake, only one maintenance probe trial was run with the toy person. During that trial, the correct responses with the toy person were again prompted and praised which produced maintenance of the responses for the duration of the study.

Insert Figure 3 about here

The data for Charles (Figure 4) show that acquisition of the play responses with the spaceship was initially slow; however, it should be recalled that Charles did not imitate prior to the study. On the sixth day of intervention, correct responses were first produced and an upward trend towards the training criterion was evident. In contrast to the data for the first toy, the correct responses across the toy frog, person and boat were observed within two days of the introduction of the training procedure. Interestingly, as with Jim's data, a brief decrease in performance (i.e. incorrect responses on three consecutive trials) was observed when training with the second toy was begun. In fact, immediately after training with the frog was introduced, Charles attempted to produce the frog responses with the spaceship.

Insert Figure 4 about here

In summary, the baseline data indicated that the patterns of responses to be trained were not produced. Across the four participants, once the training procedures were introduced, correct responses were observed and the training criterion was rapidly met.

Within Stimulus Set Generalization Training

After the participants had acquired the specific responses taught to the four first example toys from the generalization probe sets, generalization training was begun. Generalization training was conducted with four sets of toys with each participant. The students were trained to play with progressively more abstract toys from each generalization training set until generalization or training had occured to all toys from a set. Table 4 summarizes the number of exemplars that required training from each set of toys across the participants. In general summary, the first two sets required more exemplars trained than did subsequent sets. For Charles, Jim, and Mick, only one exemplar required training within the last two sets.

Insert Table 4 about here

The generalization training data for Mick are represented in Figures 5, 6, 7 and 8. Mick's data have been selected for presentation because his performance was representative of the other participants. Figure 5 shows the first set of toys (boats) that recieved multiple exemplar generalization training. The data shows that after training had begun with the first three exemplars, generalization occurred to the fourth example. Altogether, four out of the five boats were trained.

Insert Figure 5 about here

Figure 6 shows the results of generalization training with the second set of toys; spaceships. After training was begun with the first two spaceships, generalization occurred to the third spaceship. The fourth and fifth spaceships required training.

Insert Figure 6 about here

Mick's third set of generalization training toys was toy bugs. After training had begun with the first toy bug, generalization occurred to the remaining untrained bugs.

Insert Figure 7 about here

Figure 8 shows the results of generalization training with the fourth set of toys; people. As with the third set, generalization was observed to four toys after training had begun with the first toy from the set. Altogther, Mick required training with ten different toys across the four sets of toys.

Insert Figure 8 about here

<u>The Functional Control of Between Stimulus Set Generalization By Within Stimulus Set Generalization</u>

Figure 9 shows the effects of generalization training across four sets of toys on the subsequent generalization of the untrained toys from the four sets to which only the first example had been trained. Within Figure 9, the graphs that are inset to the right show the cumulative generalization of play responses to toys within the generalization training sets. The longer graphs underneath each inset graph show the cumulative generalization of the untrained toys from the generalization probe sets.

Mick's data indicated that between set generalization (ie. generalization to the untrained toys from sets from which only the first example was trained) did not begin until generalization training had proceeded within the second set of toys during generalization training. Between stimulus set generalization occurred rapidly as generalization training proceded through the third and fourth sets of toys. By the end of within set generalization training, Mick had spontaneously generalized to all 16 of the untrained generalization probe toys.

The data for Charles are represented in Figure 9 immediately below Mick's data. The inset graph shows that Charles generalized to 14 toys across the four sets of generalization training toys. The lower graph for Charles shows that between stimulus set generalization occurred with one toy on the last day of training of the first set of within stimulus set generalization training toys. As training progressed through second and third sets Charles generalized to progressively more toys. By the end of training Charles had generalized to nine toys from the sets to which only the first example had been trained.

Jane's data (located under the data for Charles) indicates that within stimulus set generalization training produced generalization to ten toys across the four sets. Between stimulus set generalization began during generalization training within the second set of toys. As generalization training proceded through the second, third, and fourth sets; Jane progressively generalized to more toys from the probe sets. By the end of training, between stimulus set generalization had occurred to 13 of the 16 untrained toys from the generalization probe sets.

Jim's data is represented in the bottom set of graphs in Figure 9. During training within the first two sets of toys Jim produced fewer generalized responses than did the other three participants; however, Jim did generalize to the maximum possible number of toys within the third and fourth sets. Jim's between set generalization data shows that he generalized to three toys prior to the onset of generalization training. These three toys and the one toy that Jim generalized to during the first training set were the untrained toy people. It should be recalled that the first toy that Jim was trained with was the first example of toy people (the set included a small "star wars" android figure, a troll doll, a gumby, a male doll dressed in conventional clothing and a cut-out wood figure). After Jim had been prompted to produce the people response following the introduction of the second first example toy, he generalized the people response not only to the remaining toy people but at least once to every untrained toy in the study (with exception of the full sized piano). Although Jim's data indicate that generalization occurred prior to the onset of generalization training, those generalized responses represent a nondifferentiated form of generalization because Jim was not discriminating people from nonpeople when producing the response. Thus, with the exception of the toy people, Jim followed a similar pattern to the other participants in that between set generalization did not occur until within stimulus set generalization training had progressed to the second set. Altogether, Jim showed between stimulus set generalization to seven toys (11 if people are included as they are in Figure 9).

All of the participants demonstrated some degree of between stimulus set generalization. Between stimulus set generalization appeared to be under control of within stimulus set generalization (with the exception of Jim's people). For Mick, Jane and Jim, generalization training within two sets was associated with the beginning of between stimulus set generalization. Even though Charles began to show between stimulus set generalization during the first generalization training set, his maximum rate of between stimulus set generalization occurred during the second generalization training set.

Patterns of Between Stimulus Set Generalization

Figures 10, 11, 12, and 13 show the pattern of generalization to untrained toys across the four participants. Within the figures, the numbers 2 through 5 designate the toy which was probed on a given day from the generalization probe set. The toys were numbered from two through five, with five being the most abstract toy within each set.

After Jane (Figure 10) had been trained to generalize to the set of toy snakes (which required training with four examples), generalization training with toy boats was begun. During generalization training with boats, she generalized to the second toy animal and the third airplane examples.

Generalization to the remaining airplanes, bugs and animals and to one spaceship occurred after generalization training had proceeded to toy tanks and to toy people.

Insert Figure 10 about here

The data for Mick (Figure 11) show that after training occurred with four examples from the set of toy boats (1,2,3 and 5) and four examples of spaceships (1,2,4 and 5), generalization first occurred to airplanes (2 and 3) and animals (2 and 5). By the time that generalization training had proceeded to the toy bugs (only the first example required training) and the set of people (only the first example required training), Mick generalized to the remaining airplanes and animals as well as to the sets of snakes and tanks.

Insert figure 11 about here

Jim's data (figure 12) show that generalization to toy people occurred prior to the initiation of generalization training. As stated previously , probes with other untrained toys showed that Jim had transferred the people response to nearly all of the toys within the sets. As training proceeded sequentially to the first examples of the snake, boat, and motorcycle, Jim would learn the new differentiated responses as they were introduced with the specific toy taught, yet would continue to produce the people response with the untrained toys from those sets. When within stimulus set generalization training was initiated, generalized responses to the snakes and motorcycles first appeared after generalization training had been conducted with toy spaceships (which required training with four examples) and with two examples from the set of toy airplanes (which eventually required training with all five examples). Jim continued to produce the people movement responses with all of the untrained toy boats throughout the duration of the study. In total, Jim displayed between stimulus set generalization with seven toys from the snake and motorcycle sets.

Insert Figure 12 about here

The graph of Charles' data (Figure 13) indicates that generalization occurred to all of the untrained toy frogs and people and to one of the toy boats after he had been trained to generalize to the sets of toy animals (trained with two examples) and airplanes (trained with two examples). Generalization was not observed to any spaceship.

Insert figure 13 about here

In total, the four participants were probed with 16 sets of toys to which only the first example from the sets had been taught. At least partial generalization was observed to 13 of those sets. The sets of boats and spaceships accounted for most incorrect responses. Most of the errors when playing with spaceships were the result of substituting the airplane responses for the spaceship responses. When playing with boats, Jim consistently substituted the people responses for the boat responses. While Charles did respond to one untrained boat correctly, he did not substitute other toy play responses with the remaining boats. Instead, he usually held the boats and slid them along the table without producing the necessary differentiating behaviors.

Generalization Probes with Reactive Toys

The acquisition, maintenance,and probe data with the sets of reactive toys are represented in Figure 14. The generalization probes with the untrained toys from the those sets are represented in the figure by the numbers 2 and 3 which correspond to the two untrained toys from the sets. These data show that although the participants acquired and maintained the play responses with the first examples from the sets, generalization did not occur to the untrained toys.

Insert Figure 14 about here

Discussion

The results indicated that when generalization training had proceeded to a sufficient number of sets of toys, there was an associated facilitation of generalization to other untrained sets of toys. Although the degree of generalization observed was impressive, there was little or no generalization to two sets of movement related toys (boats and spaceships). With the exception of one of Jim's toy sets, the occurrence of between stimulus set generalization was dependent on exposure to within stimulus set generalization training. Maximal between stimulus set generalization occurred upon introduct'on of the second set of toys during generalization training.

Importantly, generalization was not observed to the toys from the sets of reactive toys. The failure to generalize to the reactive toys could be due to several possible factors; the discrimination of the defining properties of the reactive toys may have been more difficult, the students may have had fewer real life experiences or histories of play with toys similar to those from the reactive sets, or a lack of some critical relationship to the other toy sets may have been responsible. The characteristics of stimuli or responses that control the spread of between stimulus set generalization warrent further discussion and experimentation. In the present investigation, the movement related toys required similar response topographies (eg. holding the toys and moving them in similar patterns). Thus it is possible that similarities in response topographies controls response mediated generalization. It is also possible that similarities in the features that require discrimination may control between stimulus set generalization. Finally, similarities or differences in effects may exert control. In the present study, the reactive toys differed from the movement related toys on at least two of these dimensions; topographies and effects.

For a clearer interpretation of these data it would be important to show that discrimination of the defining attributes of each set was of comparable difficulty across the sets of movement related and reactive toys. Although the sets were constructed so that at a subjective level the discriminations required seemed to be of comparable difficulty, the study does not provide an empirical demonstration of the similarity. A partial control for this problem was provided by including a wide range of objects within each set, so as to produce a realistic range in difficulty of determining whether or not a given toy was an example of a set. When the participants did generalize to a set, they generalized to the full range of toys within the set with only three exceptions (Jane's spaceships; Charles' boats; and Jim's motorcycles), In addition, the participants did not generalize to the untrained reactive toys even though the toys were quite similar in some cases (e.g. the full size piano and the smaller plastic piano). This suggests, though only circumstantially, that it was not simply the difficulty of classifying the toys or discriminating the controlling properties which accounted for the between stimulus set generalization observed and the lack of generalization to the reactive toys. If this argument can be made more convincing (with additional studies in the future), these data may indicate that if generalization is an operant which can be trained as Parsonson and Baer (1978) suggested, the parameters which control a generalization operant, may be relatively specific to the task, materials or context within which the responses were trained and probed.

It should be stressed that the findings of the present study are preliminary and that there is a lack of comparable research concerning response mediated generalization which could aid intrepretation of these data. The inference that response-response relationships were responsible for the generalization observed, or even that response mediated generalization exists as a phenomenon is premature. The study showed that a package of treatment strategies; multiple exemplar generalization training, the organization of training so that potentially related responses are trained in close temporal proximity, reinforcement for generalizing responses during training, and grading the objects into ranges of color, size, and abstractness, was associated with the observed degree of generalization.

Explanations of the formation of response-response relationships usually concern either a) the close temporal occurrence of responses, b) the functional similarity of the responses in producing some effect and/or c) similar antecedent, controlling variables. The present study suggests that it may be useful to investigate the formation of response interrelationships with a finer grained analysis in order to identify stimulus and response related features which may control generalization.

The training procedure was effective in teaching the participants independent play skills which they formerly lacked. The play skills taught were selected on the basis of observing the natural play of nonhandicapped students in free, parallel play situations. In such situations, children typically play with a number of different toys and in fact often play with toys they have just observed other children manipulating. Thus, the wide variety of toys to which the children could produce age appropriate, normalized responses was greatly increased as a result of the study. It should be pointed out that normalized responses in play situations may be a significant vehicle for the social integration of children with moderate and severe handicaps. As such, future investigations of training procedures designed to promote parallel play behaviors should include not only procedures designed to promote play with large numbers of commonly available toys, but should include social validity evaluations of the subsequent play responses by nonhandicapped peers.

In conclusion, the present study proposes a training strategy based on the theoretical influence of response interrelationships on stimulus generalization. It is apparant that there are a number of ways in which responses can form interrelationships and there are multiple effects that such relationships may exert on the learning, performance and generalization of responses. It is hoped that continued research in this relatively new area of investigation will lead to increased efficiency of instructional programs without concomitant increases in the complexity of instructional technology.

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Table One

Descriptive Characteristics of Students

Participant	Age	Primary Handicapping Condition	IQ Estimate (Stanford Binet form L-M)	MEAN Performance across subscales of AAMD Adaptive Behavior Scale (TMR Norms)
Mick	7 yrs, 10 mos	Severely Handicapped, Down syndrome	37	50th percentile
Charles	7 yrs, 5 mos	Severely Handicapped, Down syndrome	25	22nd percentile
Jim	4 yrs 2 mos	Moderately Handicapped	50	65th percentile
Jane	4 yrs 6 mos	Moderately Handicapped, Down syndrome	50	70th percentile

Table 2

The Sequence of Addition of Details to Toys

And The Characteristics of the Reactive Toys

Toy Set	Defining Properties	Sequence of Additional Details
Movement Toys		
Airplanes	Fuselage cylindrically shaped and rounded wing surfaces	1. windows, markings, engines, wheels, surface detail, cockpit, tail 2. windows, markigns, engines, wheels, surface detail 3. windows, markings, engines 4. windows 5. abstract shape, just defining properties
Boats	Rectangular section with triangular, boat shaped front surface	1. markings, engine, rudder, cabin, surface detail 2. markings, engine, rudder, cabin 3. markings, engine, rudder 4. markings 5. abstract shape, just defining properties
Snakes	Cylindrical shape	1. tongue, body segments, teeth, bodybumps, eyes, mouth 2. tongue, body segments, teeth, bodybumps, eyes 3. tongue, body segments, teeth, bodybumps 4. tongue, body segments 5. abstract shape, just defining properties
Tanks	Rectangular shape with segmented treads on lower surface	1. bogies, body detail, exterior top shape, turret detail, gun 2. bogies, body detail, exterior top shape, turret detail 3. bogies, body detail, exterior shape 4. bogies, body detail 5. abstract shape, just defining properties

Space ships	Cylindrical engine shapes attached to cylindrical fuselage	1. engine details, body details, cockpit, landing feet 2. engine details, body details, cockpit 3. engine detials, body details 4. engine details 5. abstract shape, just defining properties
Animals	Cylindriacl body shape with four legs and offset rectangle on top of body to simulate a head	1. eyes, mouth, feet, ears, tail, leg details, fur, foot details 2. eyes, mouth, feet, ears, tail, leg details 3. eyes, mouth, feet, ears, tail 4. eyes, mouth, feet 5. abstract shape, just defining properties
Motorcycles	Two circular solid surfaces attached to rectangular shape	1. seat, wheel details, handle bars, spokes, color details, suspension 2. seat, wheel details, handle bars, spokes, color details, 3. seat, wheel details, handle bars 4. seat, wheel details 5. abstract shape, just defining properties
[illegible]gs	Long, thin, pointed body with six legs	1. tail, head, face detail, color detail, wing detail, eyes, feet 2. tail, head, face detail, color detail, wing detail 3. tail, head, face detail 4. tail 5. abstract shape, no details, cylindrical body, six cylindrical legs
Frogs	Rectangular body with bent back lets and	1. feet, head shape, arm shape, body detail, eyes, mouth 2. feet, head shape, arm shape, 3. feet, head shape, arm shape 4. feet, head shape 5. abstract shape, just defining properites
People	Square head, rectangular body with rectangular arms and legs	1. hands, eyes, face details, body details, clothing details 2. hands, eyes, face details, body details 3. hands, eyes, face details 4. hands, eyes 5. abstract shape, just defining properties

Reactive Toys	
Wind-ups	1. toy drill 2. toy bear 3. toy car
Keyboard instruments	1. small plastic piano 2. magic flute (an electronic toy that was a long plastic rod with colored keys) 3. a full size piano

Table 3

Response Definitions

Toy Type	Response
Movement Toys	
Airplanes	hold plane, move plane through the air at angles less than 90 , land at angles less than 90
Spaceships	hold spaceship, move spaceship in circular pattern, land spaceship at 90 angle
Boats	hold boat by its top, move on the floor, pitching nose of boat up and down
Tanks	hold tank by its top, move slowly in a staraight line, then make a sharp 90 turn
Animals	hold animal by its top, move on the floor, move back and forth while in motion to simulate movement of limbs
People	hold doll by back or front, move side to side during motion to simulate walking
Bugs or Frogs	hop or jump toys in a straight line
Snakes	move toy side to side while in forward motion to produce a sign wave-like movement
Motorcycles	grasp by top, move in straight line and raise front end while moving at least 6 inches to simulate a "wheelie"
Reactive Toys	
Wind-ups	observe toy to find round key, rotate key until resistance is felt, place on table and observe
Music Toys	produce the sequence of notes by pressing keys starting with middle key followed by the next two adjacent keys (e.g. the notes C, D, E).

Table 4

Numbers of Exemplars Requiring Training as a Function of the Number of Stimulus Sets Taught

PARTICIPANT	SET 1	SET 2	SET 3	SET 4
Jane	3	3	2	2
Jim	4	5	1	1
Charles	2	2	1	1
Mick	4	4	1	1
Means	3.25	3.5	1.25	1.25

Figure Captions

Figure 1. Percent correct toy play responses during baseline, training and maintenance conditions for Jane.

Figure 2. Percent correct toy play responses during baseline, training and maintenance conditions for Mick.

Figure 3. Percent correct toy play responses during baseline, training and maintenance conditions for Jim.

Figure 4. Percent correct toy play responses during baseline, training and maintenance conditions for Charles.

Figure 5. Results of within stimulus set generalization training on Mick's first set of toys: Boats. The asterisk and dashed line indicate that spontaneous generalization occurred.

Figure 6. Results of within stimulus set generalization training on Mick's second set of toys: spaceships. The asterisk and dashed line indicate that spontaneous generalization occured.

Figure 7. Results of within stimulus set generalization training on Mick's third set of toys: bugs. The asterisk and dashed line indicate that spontaneous generalization occurred.

Figure 8. Results of within stimulus set generalization training on Mick's fourth set of toys: people. The asterisk and dashed line indicate that spontaneous generalization occurred.

Figure 9. Cumulative generalization within stimulus sets and between stimulus sets across the four participants. On the inset upper graph for each participant, the cumulative generalization to toys within each training set is displayed. On the lower graph for each participant, unreinforced probes for between stimulus set generalization during baseline, first exemplar training, maintenance trials and within stimulus set generalization training.

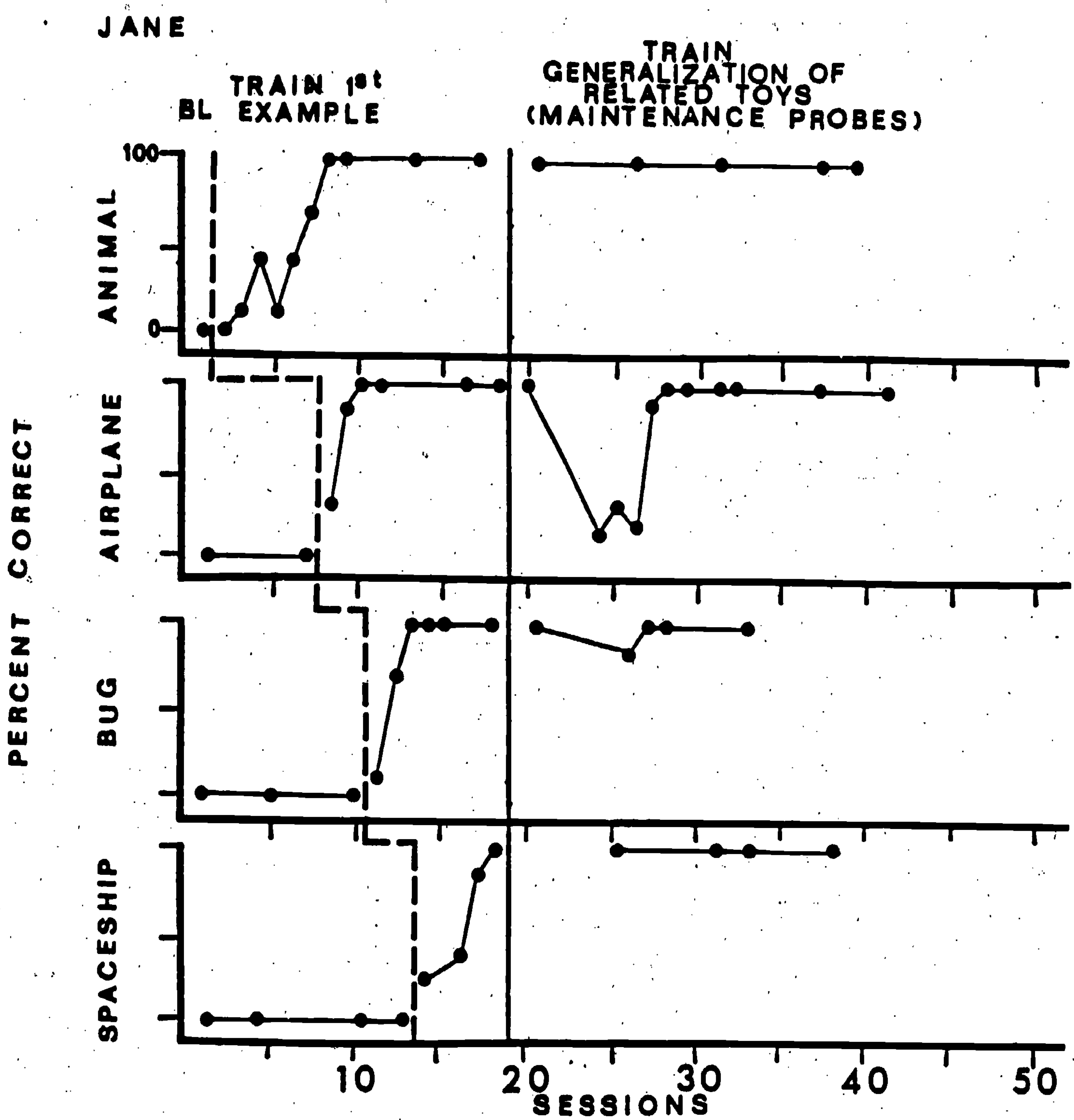
Figure 10. The occurrence or nonoccurrence of Jane's generalized play responses across sets of animals, airplanes, bugs and spaceships during conditions: training to play with the first examples from the sets and generalization training with movement related sets. (The numbers 2, 3, 4, 5 designate specific toys in each set).

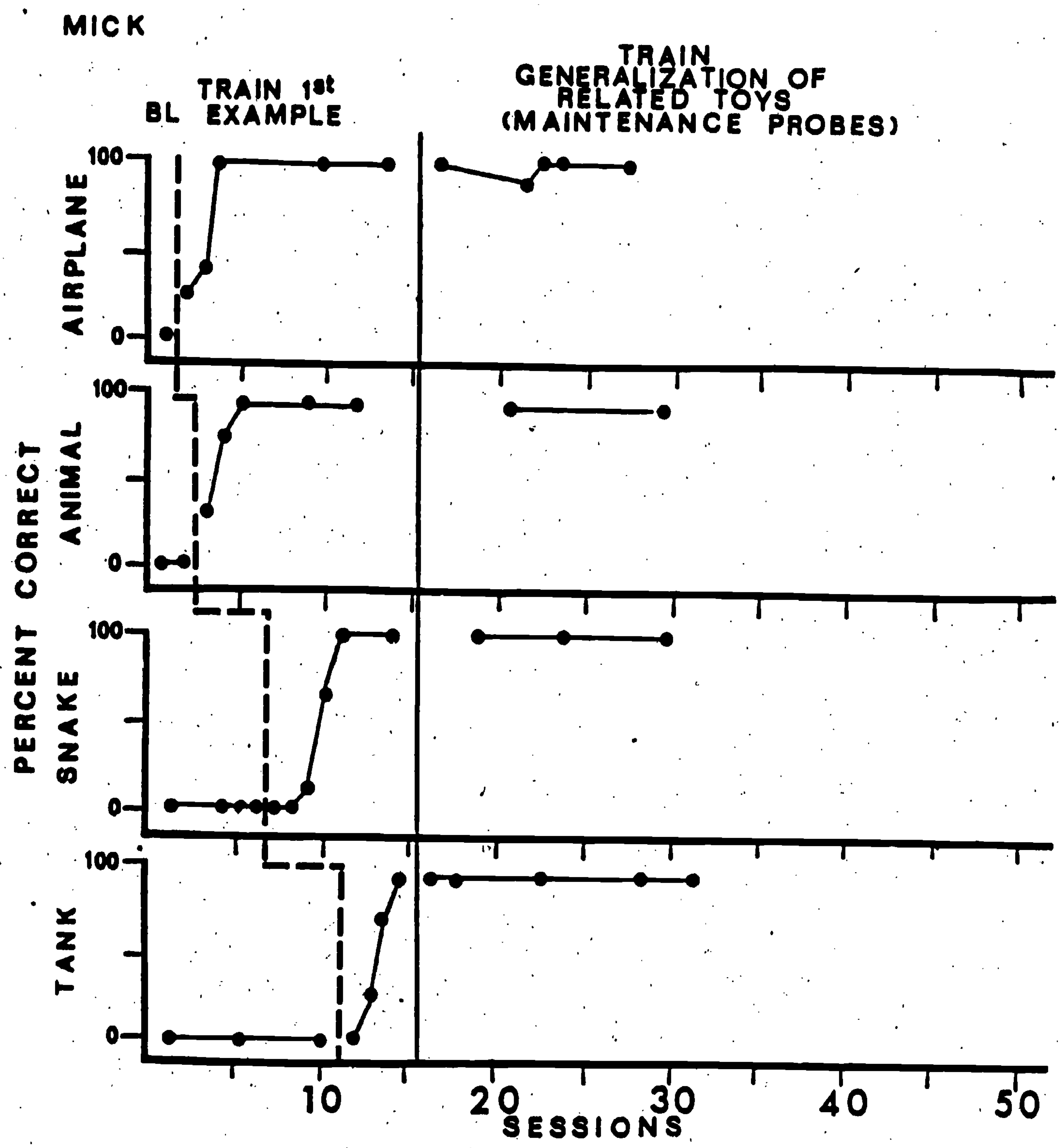
Figure 11. The occurrence or nonoccurrence of Mick's generalized play responses across sets of airplanes, animals, snakes and tanks during conditions: training to play with the first examples from the sets and generalization training with movement related sets. (The numbers 2, 3, 4, 5 designate specific toys in each set).

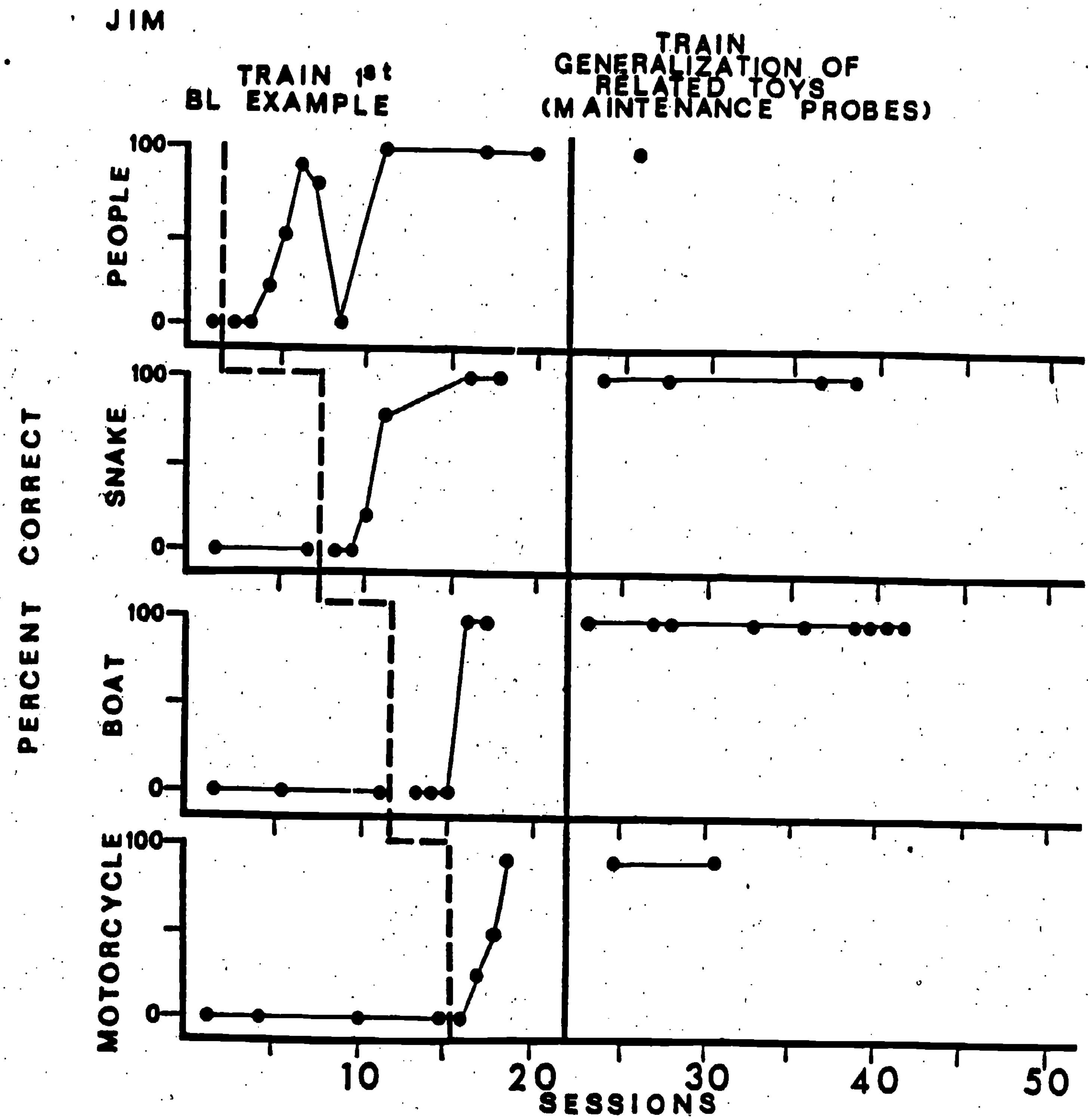
Figure 12. The occurrence or nonoccurrence of Jim's generalized play responses across sets of people, snakes, boats, and motorcycles during conditions: training to play with the first examples from the sets and generalization training with movement related sets. (The numbers 2, 3, 4, 5 designate specific toys in each set).

Figure 13. The occurrence or nonoccurrence of Charles' generalized play responses across sets of spaceships, frogs, people and boats during conditions: training to play with the first examples from the sets and generalization training with movement related sets. (The numbers 2, 3, 4, 5 designate specific toys in each set).

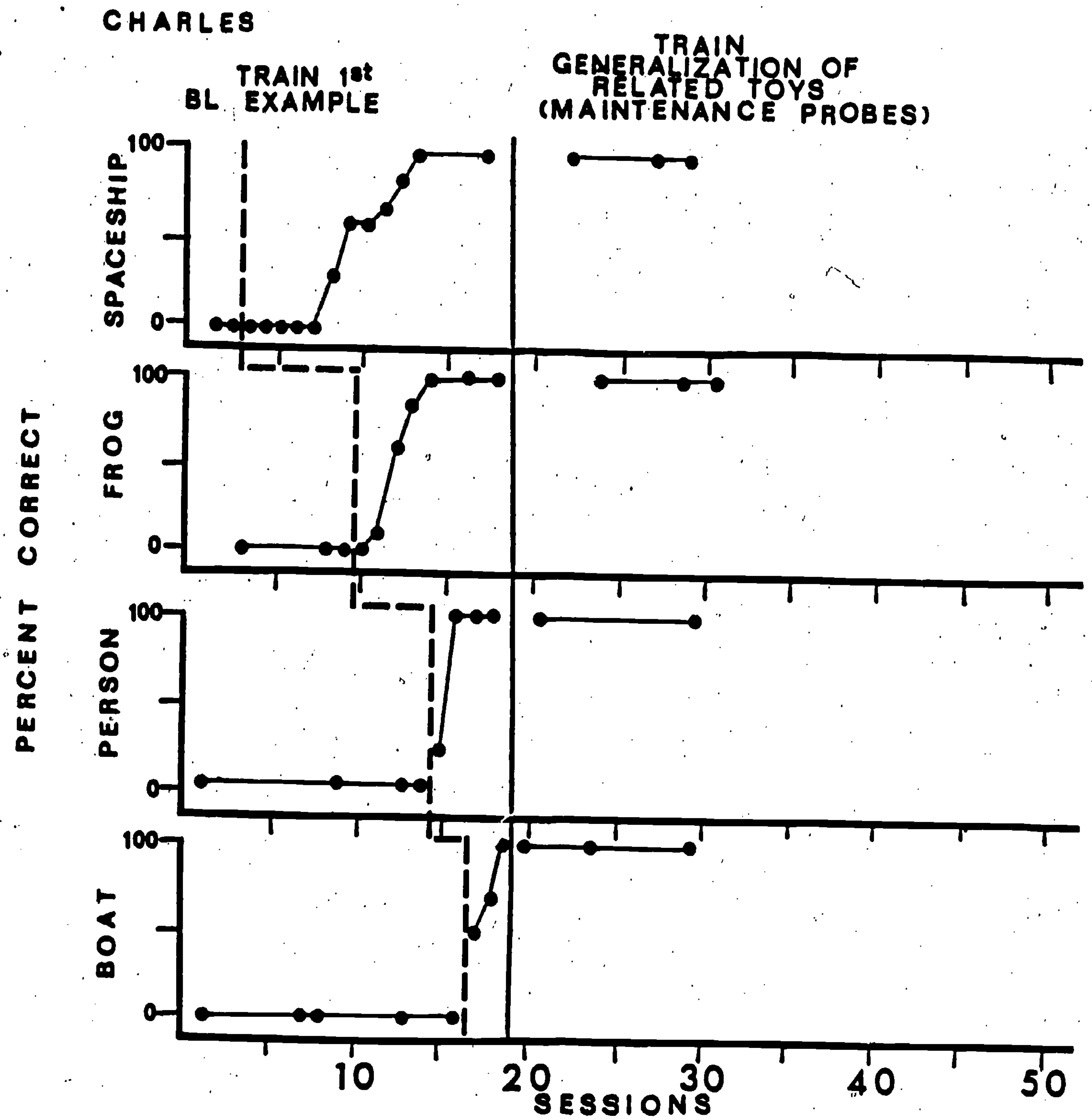
Figure 14. Results of training and generalization trials with reactive toys for James, Mick, Charles and Jim. (The dots represent the percent age of correct training trials with the first examples from the sets. The numbers 2 and 3 designate the other two toys in each reactive set which were probed.)

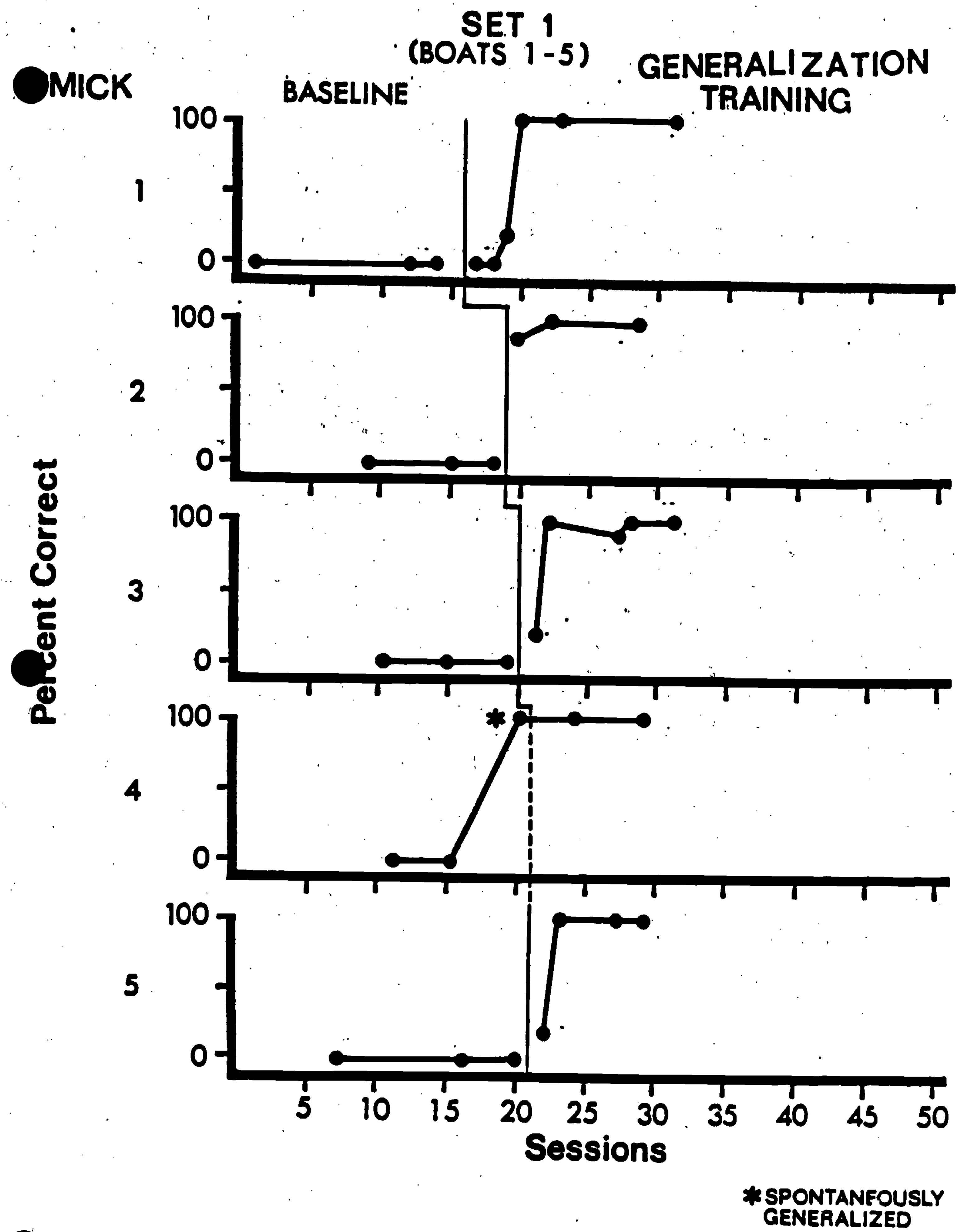

JANE
BL
TRAIN 1st EXAMPLE
TRAIN GENERALIZATION OF RELATED TOYS (MAINTENANCE PROBES)
PERCENT CORRECT
100
0
ANIMAL
AIRPLANE
BUG
SPACESHIP
10
20
30
40
50
SESSIONS

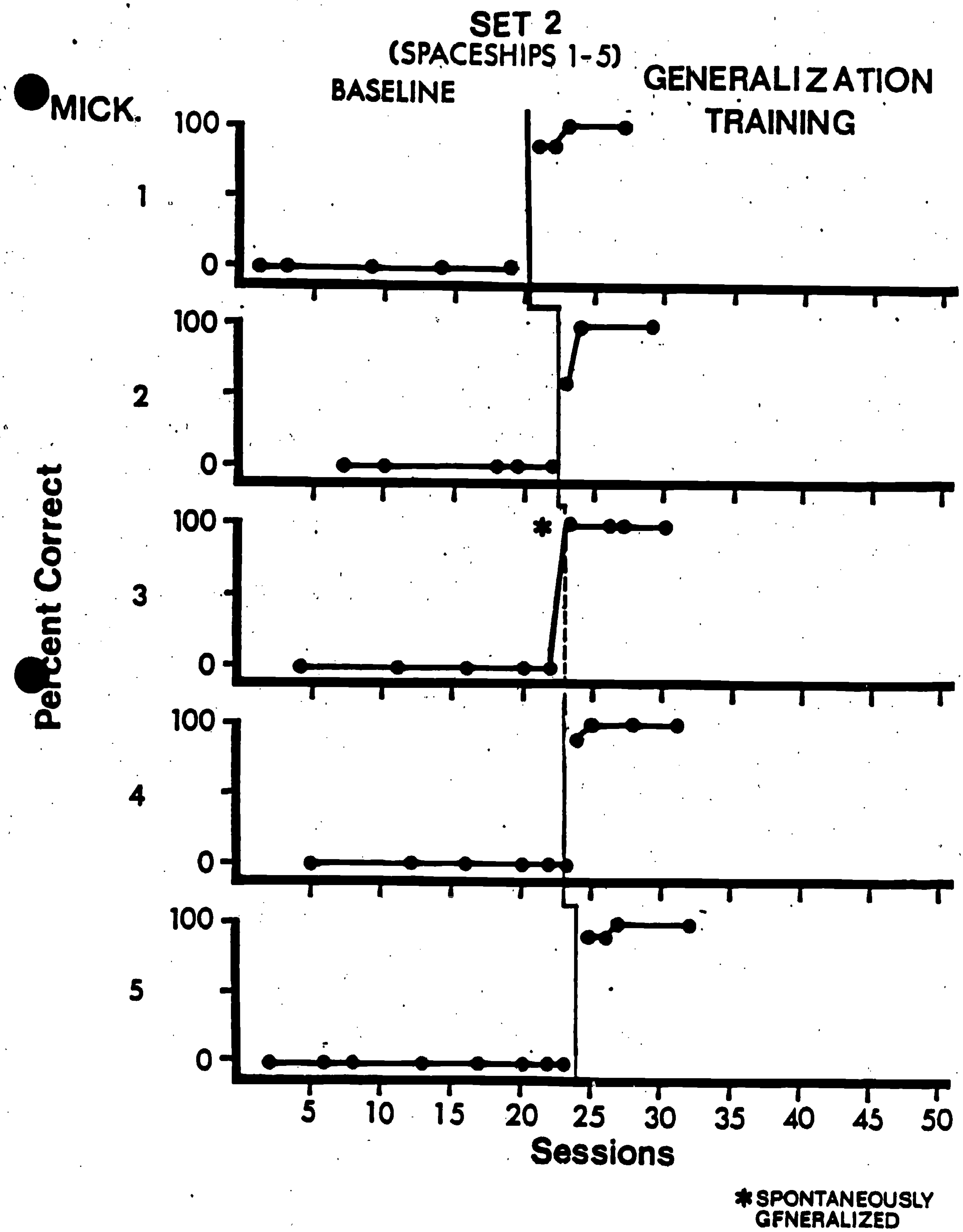

MICK
BL
TRAIN 1st EXAMPLE
TRAIN GENERALIZATION OF RELATED TOYS (MAINTENANCE PROBES)
PERCENT CORRECT
AIRPLANE
ANIMAL
SNAKE
TANK
100
0
10
20
30
40
50
SESSIONS

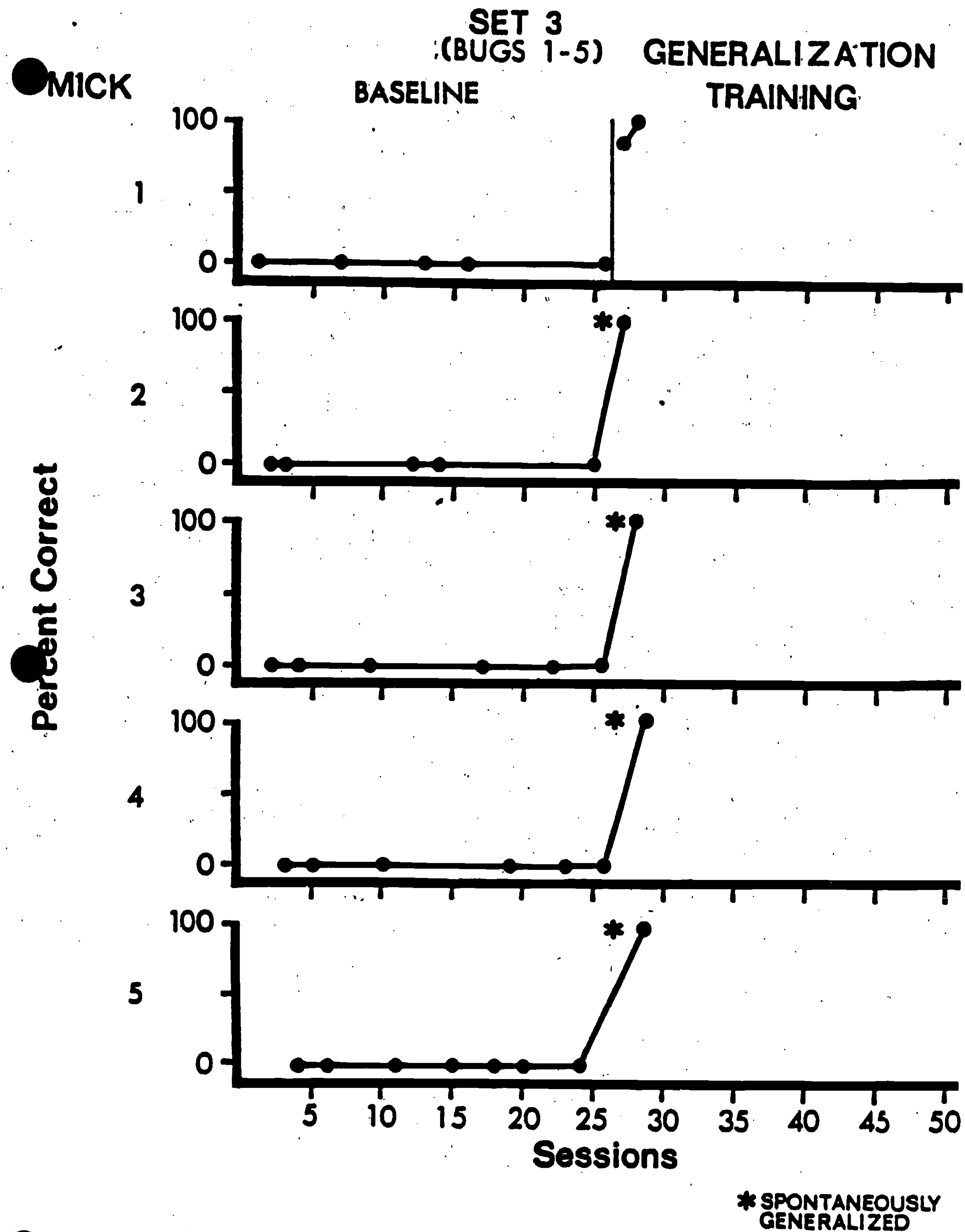


JIM
TRAIN 1st
BL EXAMPLE
TRAIN
GENERALIZATION OF
RELATED TOYS
(MAINTENANCE PROBES)
PERCENT CORRECT
PEOPLE
SNAKE
BOAT
MOTORCYCLE
100
0
10
20
30
40
50
SESSIONS

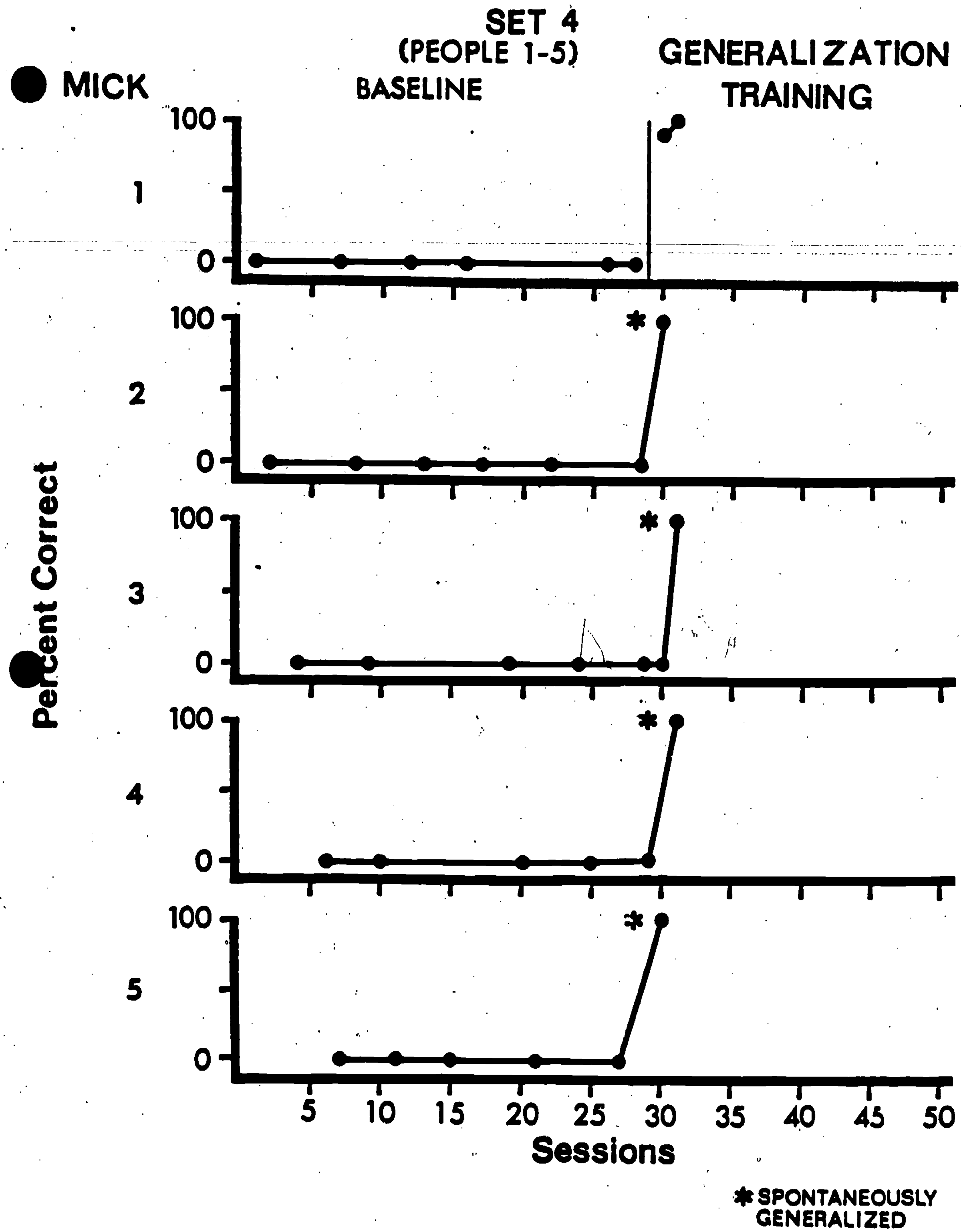

CHARLES
BL
TRAIN 1st EXAMPLE
TRAIN GENERALIZATION OF RELATED TOYS (MAINTENANCE PROBES)
PERCENT CORRECT
SPACESHIP
FROG
PERSON
BOAT
100
0
10
20
30
40
50
SESSIONS

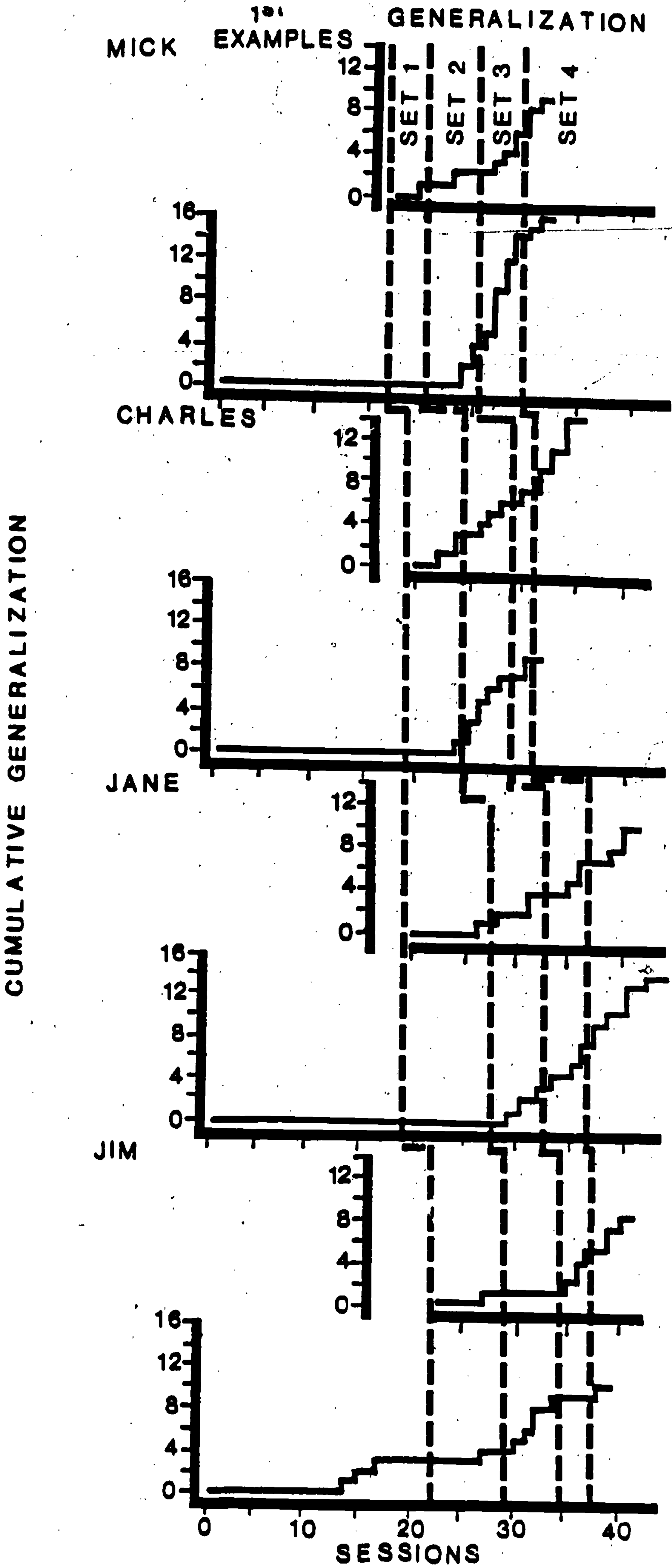

SET 1
(BOATS 1-5)
MICK
BASELINE
GENERALIZATION TRAINING
Percent Correct
100
0
1
2
3
4
5
5 10 15 20 25 30 35 40 45 50
Sessions
* SPONTANFOUSLY GENERALIZED


SET 2
(SPACESHIPS 1-5)
BASELINE
GENERALIZATION
TRAINING
MICK.
Percent Correct
100
0
1
2
3
4
5
5 10 15 20 25 30 35 40 45 50
Sessions
* SPONTANEOUSLY
GFNERALIZED

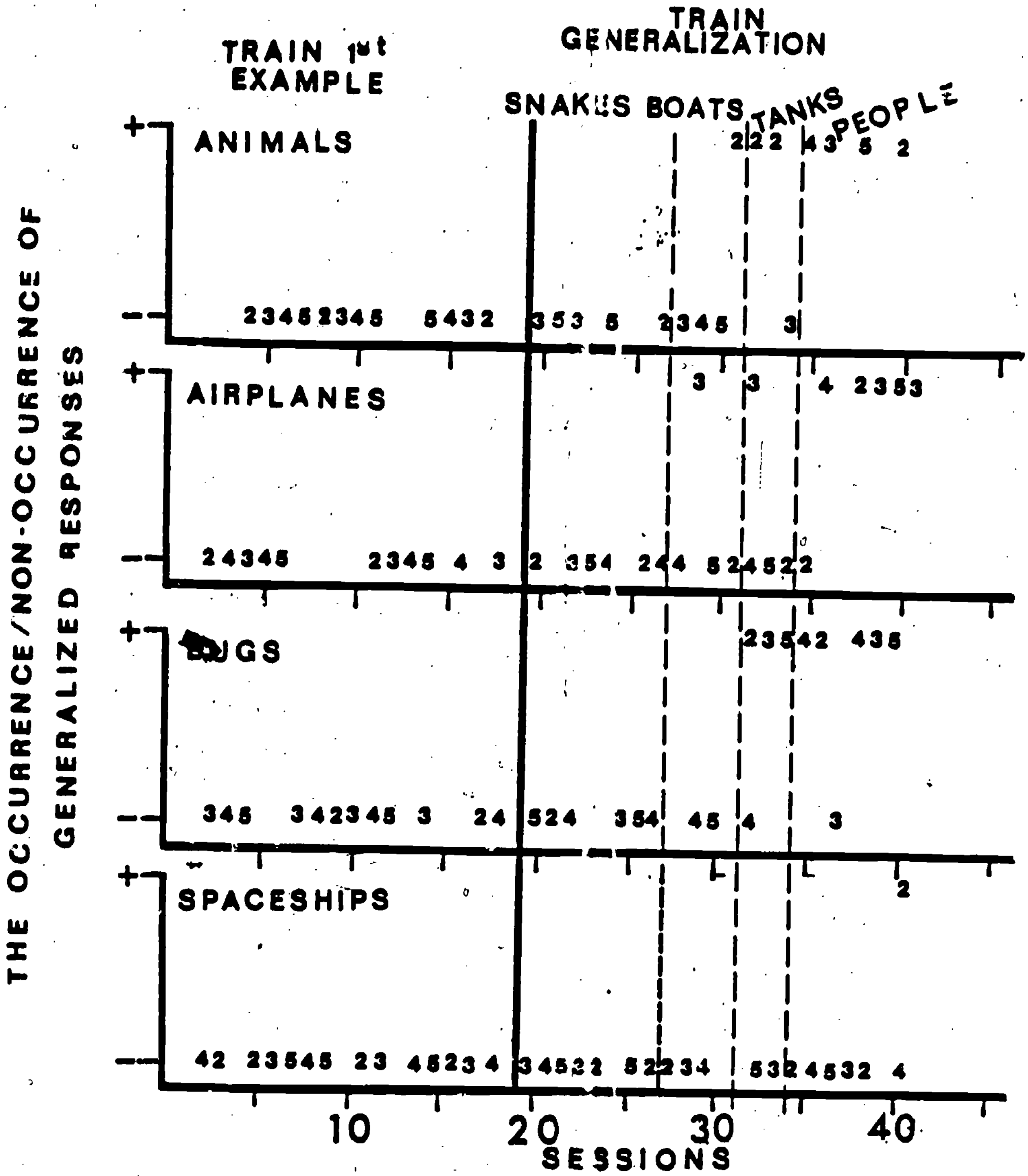


MICK
SET 3
(BUGS 1-5)
BASELINE
GENERALIZATION
TRAINING
100
0
1
2
3
4
5
Percent Correct
5
10
15
20
25
30
35
40
45
50
Sessions
* SPONTANEOUSLY GENERALIZED

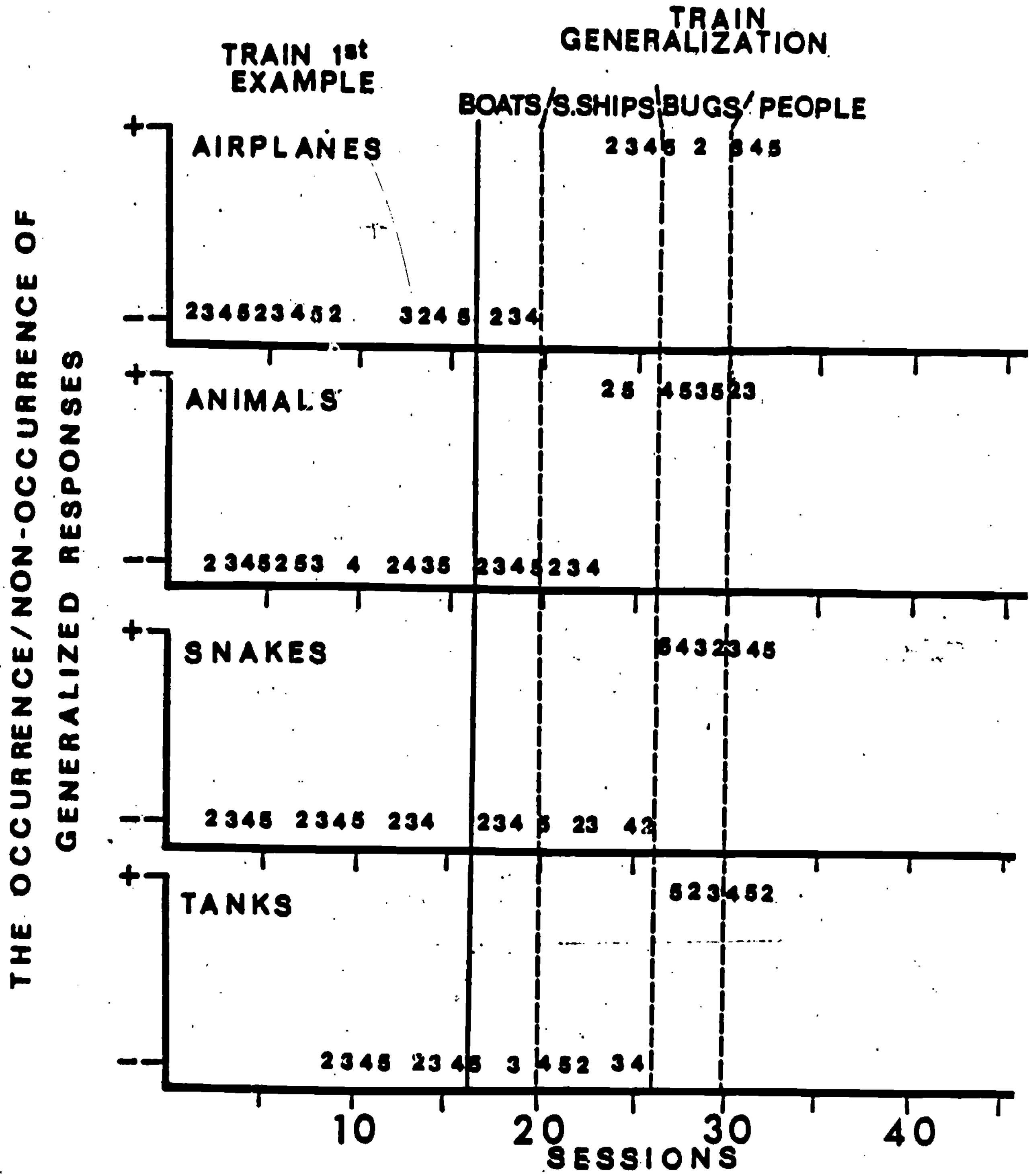

SET 4
(PEOPLE 1-5)
BASELINE
GENERALIZATION
TRAINING
MICK
Percent Correct
100
0
1
2
3
4
5
5
10
15
20
25
30
35
40
45
50
Sessions
* SPONTANEOUSLY
GENERALIZED


1st EXAMPLES
GENERALIZATION
MICK
SET 1
SET 2
SET 3
SET 4
CHARLES
JANE
JIM
CUMULATIVE GENERALIZATION
SESSIONS
0
10
20
30
40
0
4
8
12
16

JANE


TRAIN 1st EXAMPLE
TRAIN GENERALIZATION
SNAKES BOATS TANKS PEOPLE
ANIMALS
AIRPLANES
BUGS
SPACESHIPS
THE OCCURRENCE/NON-OCCURRENCE OF GENERALIZED RESPONSES
10
20
30
40
SESSIONS

MICK


TRAIN 1st EXAMPLE
TRAIN GENERALIZATION
BOATS
S.SHIPS
BUGS
PEOPLE
AIRPLANES
ANIMALS
SNAKES
TANKS
THE OCCURRENCE/NON-OCCURRENCE OF GENERALIZED RESPONSES
10
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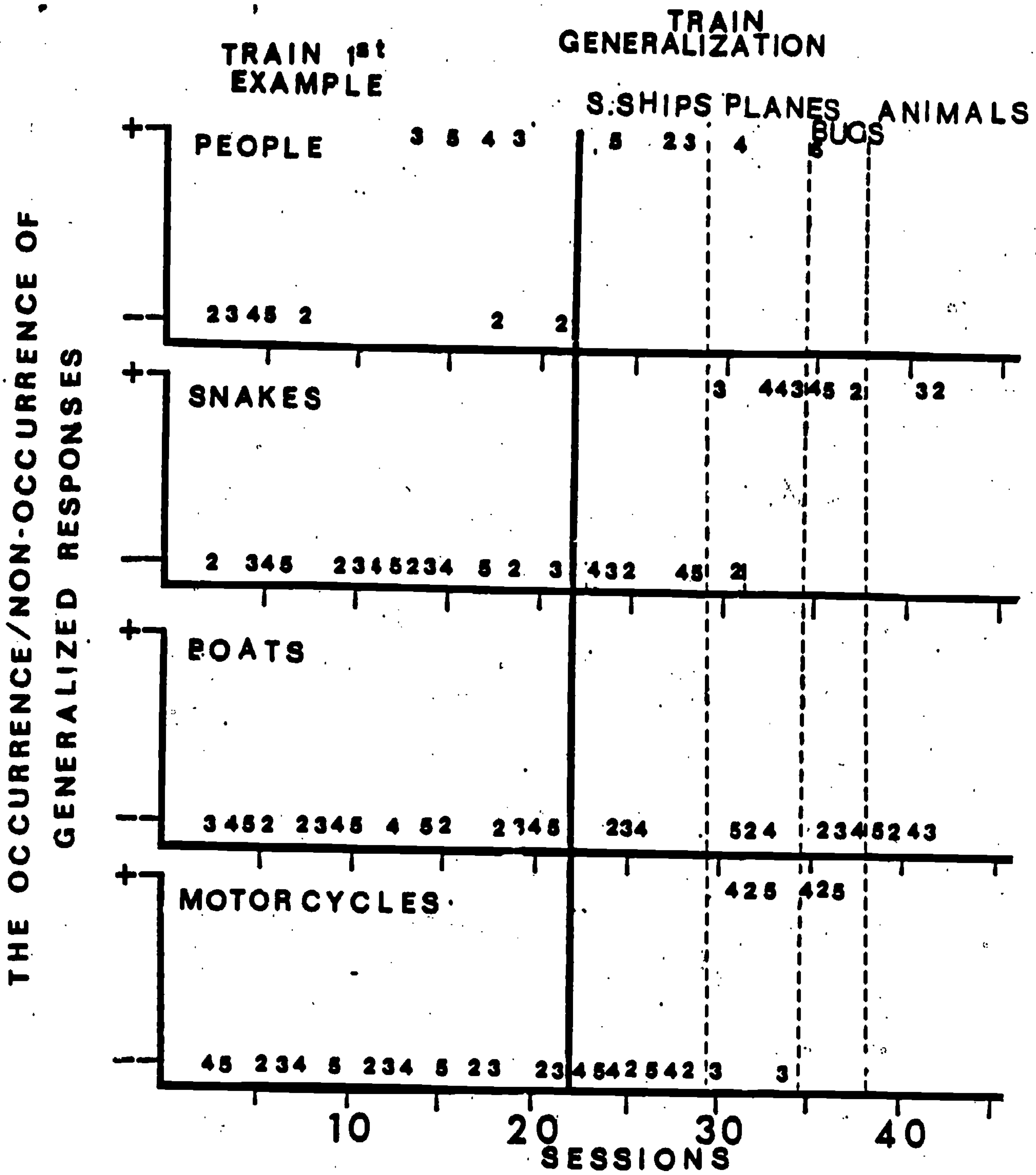
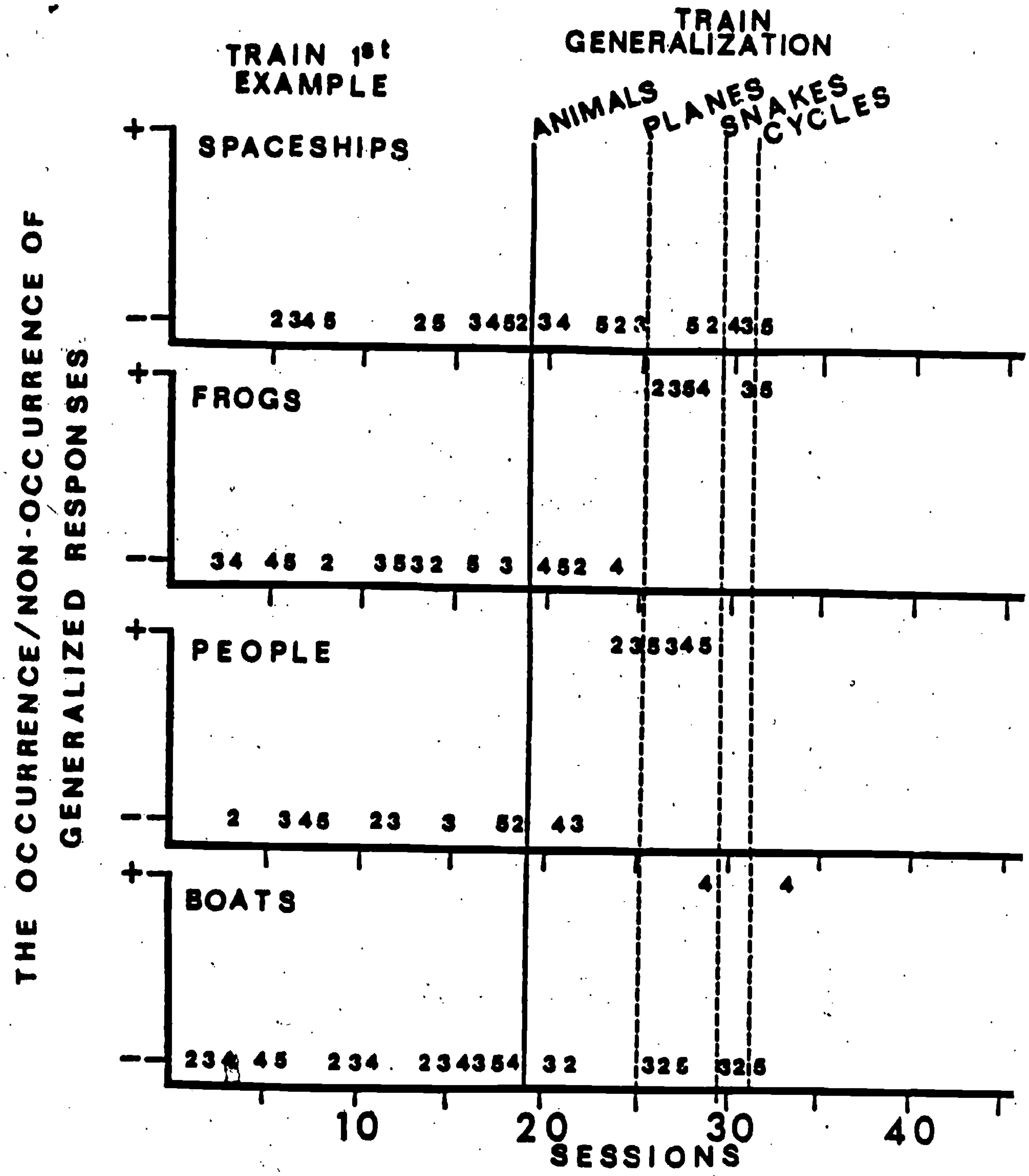
40
SESSIONS

JIM


TRAIN 1st EXAMPLE
TRAIN GENERALIZATION
S.SHIPS
PLANES
BUGS
ANIMALS
PEOPLE
SNAKES
BOATS
MOTORCYCLES
THE OCCURRENCE/NON-OCCURRENCE OF GENERALIZED RESPONSES
SESSIONS
10
20
30
40

CHARLES


TRAIN 1st EXAMPLE
TRAIN GENERALIZATION
ANIMALS
PLANES
SNAKES
CYCLES
SPACESHIPS
FROGS
PEOPLE
BOATS
THE OCCURRENCE/NON-OCCURRENCE OF GENERALIZED RESPONSES
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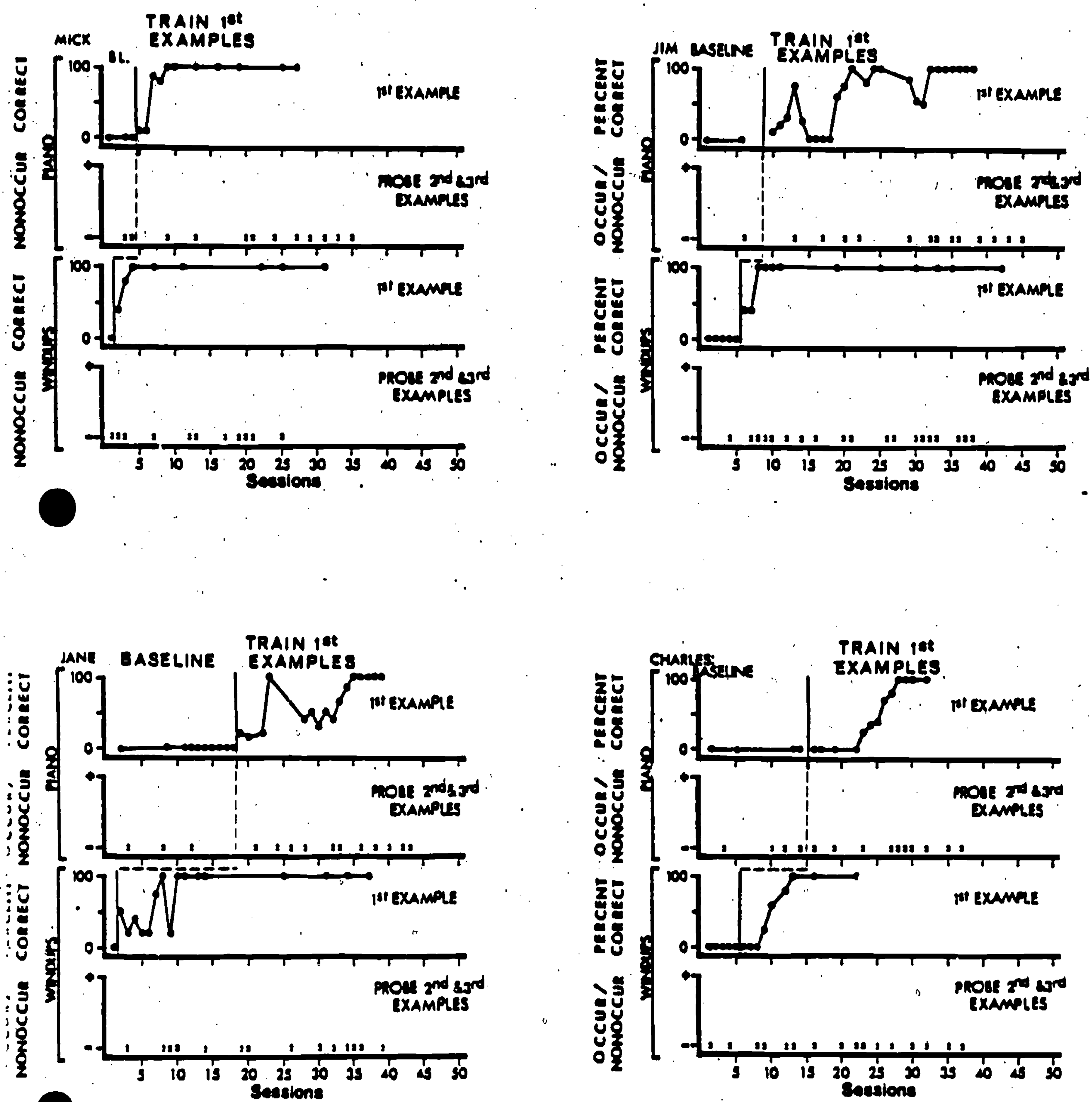
SESSIONS



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